

U.S. Patent Application Serial No. 09/881,836
Response dated January 21, 2004
Reply to OA of **October 21, 2003**

IN THE CLAIMS

Please cancel claims 1-4 and 6 without prejudice or disclaimer.

Please add new claims 7-11 as follows:

Claim 1-4 (Canceled).

Claim 5 (Withdrawn): A process for growing doubly doped lithium niobate crystal as claimed in anyone of Claims 1-4, wherein said process includes the following steps:

(1) Weigh up high purity Li_2CO_3 , Nb_2O_5 , Fe_2O_3 and MgO , In_2O_3 or ZnO powders according to the crystal composition, and dry them at $120\sim 150^\circ\text{C}$, then thoroughly mix them lasting for 24 hours, and keep them at $800\sim 850^\circ\text{C}$ for 2~5 hours to make Li_2CO_3 decompose sufficiently, and then sinter at $1050\sim 1150^\circ\text{C}$ for 2~8 hours to obtain doubly doped lithium niobate powder.

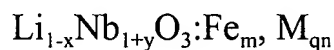
(2) Put the above doped lithium niobate powder into a Pt crucible after impacted, then heat the powder by a middle frequency stove; Grow the doubly doped lithium niobate crystals using the Czochralski pulling method along c or a axis via the procedures of necking, shouldering, uniform-diametering, and tailing, with the pulling rate being 1~3 mm/h, the rotation rate being 15~30 rpm, the temperature difference of the melt-crystal interface being 20°C , the temperature gradient in the melt volume near the surface being $1.5^\circ\text{C}/\text{mm}$, the temperature gradient above the melt surface being $1.0^\circ\text{C}/\text{mm}$, respectively.

(3) Pole and anneal the grown doped lithium niobate crystals at 1200°C to obtain single-domained doubly doped lithium niobate crystals.

Claim 6 (Canceled)

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Claim 7 (New): A doubly doped lithium niobate crystal, comprising:



where, M is a member selected from the group consisting of Mg, Zn, and In, provided when M is Mg or Zn, $q=2$, and when M is In, $q=3$;

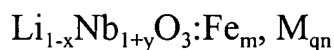
x is in the range of $0.05 \leq x \leq 0.13$;

y is in the range of $0.00 \leq y \leq 0.01$;

m is in the range of $5.0 \times 10^{-5} \leq m \leq 7.5 \times 10^{-4}$; and

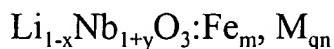
qn is in the range of $0.02 \leq qn \leq 0.03$.

Claim 8 (New): The doubly doped lithium niobate crystal as claimed in claim 7, said



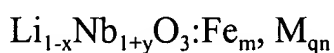
is doped with 0.007 to 0.03 wt% Fe, and M is 1.0 to 5.0 mol% Mg, where the congruent composition is $[\text{Li}]/[\text{Nb}] = 0.90:0.95$.

Claim 9 (New): The doubly doped lithium niobate crystal as claimed in claim 7, said



is doped with 0.01 to 0.05 wt% Fe, and M is 0.75 to 3.0 mol% In, where the congruent composition is $[\text{Li}]/[\text{Nb}] = 0.91:0.95$.

Claim 10 (New): The doubly doped lithium niobate crystal as claimed in claim 7, said



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is doped with 0.02 to 0.06 wt% Fe, and M is 1.5 to 6.5 mol% Zn, where the congruent composition is $[\text{Li}]/[\text{Nb}] = 0.87:0.95$.

Claim 11 (New): A three-dimensional optical storage material, comprising the doubly doped lithium niobate crystals as claimed in any one of claims 7-9 or 10.